

repeating steps (f-7) through (f-12) as many as the vertical strings shown in Figure 2, that is 182 times.

For example, if there is an error-containing code in the sixth line of the second sector in the vertical first code word, the system control unit 1 receives, as the error correcting position signal 24, "19" indicating the position of the code word from the head position in the vertical direction and stores this.

Thus, the horizontal error correction and the vertical error correction are executed in a similar manner except for the following:

- (1) the direction of reading data;
- (2) whether or not EDCs are calculated in parallel with syndromes; and
- (3) which of the error-containing code word signal and the error correcting position signal is outputted

Finally, the third-time error correction for the first ECC block will be described as follows.

Using the error-containing code word signal 23 found in the first-time error correction and the error correcting position signal 24 found in the second-time error correction, the system control unit 1 determines whether the error-containing code has been detected and the error has been corrected within the valid range of the mid-term results of the EDCs at the second-time error correction, that is, whether the mid-term results of the EDCs are valid or not.

The mid-term results of the EDCs obtained in the first-time error correction are valid unless the error correction is done within the valid

range of the mid-term results of the EDCs. In this case, data transfer is started from the code word on the  $n$ -th line indicated by the error-containing code word signal 23 found in the first-time error correction so as to perform syndrome calculation, and in parallel with the syndrome calculation, error detection is performed using the mid-term results of the EDC held in the third mid-term result register 83. On the other hand, when an error in data is corrected within the valid range of the mid-term results of an EDC, the mid-term results of the EDC are invalid, and data transfer is started from the head code word in the sector from which the error-containing code has been detected.

Step (f-13): in order to execute the third-time error correction for the third ECC block, the system control unit 1 outputs the DMA command 12 to the DMA control unit 2 so as to provide instructions to transfer data corresponding to a horizontal code word in the third ECC block from the buffer memory 4 to the syndrome calculator 5 and to the error detector 72.

Step (f-14): the DMA control unit 2 outputs the DMA request 13 to the bus control unit 3 so as to request the data transfer from the buffer memory 4 to the syndrome calculator 5 and to the error detector 72.

Step (f-15): the bus control unit 3 puts the data bus 11 in commission, and outputs the buffer memory access signal 14 to the buffer memory 4 to read data therefrom. The bus control unit 3 then outputs the syndrome data supply signal 15 and the error detector data supply signal 20 to the syndrome calculator 5 and the error detector 72, respectively, so as to supply the data read from the buffer memory 4 to the syndrome calculator 5 and to the error detector 72.

Step (f-16): the syndrome calculator 5 calculates a syndrome 16 of the transferred horizontal code word, and outputs the syndrome 16 to the error corrector 61. If the code word contains an error-containing code or if the syndrome is not zero, the syndrome calculator 5 outputs the error-containing code detection signal 22 to the error detector 72 and to the system control unit 1. The syndrome calculator 5 also provides the system control unit 1 with the error-containing code word signal 23 indicating the code word from which an error has been detected.

The error detector 72 executes an error detecting process for the transferred data in parallel with the syndrome calculator 5. Prior to the error detection, the mid-term results of the EDCs in the preceding code words stored in the third mid-term result registers 83 are reloaded. If the syndrome is zero when the transfer of the code words is over, the mid-term results of the EDCs are stored in the third mid-term result register 83 again. When the syndrome is not zero, on the other hand, the mid-term results of the EDCs in the preceding code words are maintained, without updating the contents of the third mid-term result register 83. In the first horizontal code word, the third mid-term result register 83 holds the mid-term results obtained in the first-time error correction. If the detection of an error is informed by the error-containing code detection signal 22, the subsequent code words are not subjected to error detection.

Step (f-17): the error corrector 61 corrects an error in the code, and transmits the access request signal 17 to the bus control unit 3 to request writing of the error-corrected data to the buffer memory 4.

Step (f-18): after putting the data bus 11 in commission, the bus